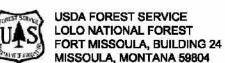
UPPER NINEMILE CREEK - HOUSUM PLACER RESTORATION PROJECT REACH 2B AND REACH 2C FINAL DESIGN

PROJECT PARTNERS



TROUT UNLIMITED
111 NORTH HIGGINS AVENUE, SUITE 500
MISSOULA, MONTANA 59802







GEUM ENVIRONMENTAL CONSULTING, INC. 307 STATE STREET HAMILTON, MONTANA 59870

PROJECT DESCRIPTION

THE NINEMILE CREEK WATERSHED IS LOCATED IN THE MIDDLE CLARK FORK RIVER WATERSHED APPROXIMATELY 20 MILES WEST OF MISSOULA, MONTANA. WITH A CONTRIBUTING AREA OF APPROXIMATELY 186 MP, THE WATERSHED ORIGINATES IN THE NINEMILE AND RESERVATION DIVIDES OF THE LOLO NATIONAL FOREST AND FLOWS 28 MILES TO THE CONFLUENCE WITH THE CLARK FORK RIVER. HISTORICAL MINING ACTIVITIES SIGNIFICANTLY ALTERED THE MORPHOLOGY AND LANDSCAPE OF THE NINEMILE CREEK VALLEY. RECORDS INDICATE THAT A PLACER GOLD BOOM OCCURRED ON NINEMILE CREEK BETWEEN 1874 AND 1977 AND MINING WITH DRAGLINES, DREDGES, HYDRAULIC HOSES AND SLUICING CONTINUED ON NINEMILE CREEK AND PRIMARY TRIBUTARIES UNTIL THE LATE 1940. THE MINING PROCESS REWORKED THE GLACIAL AND FLUVIAL SEDIMENTS COMPRISING THE VALLEY BOTTOM. ALLUVIAL SEDIMENTS WERE WORKED INTO NUMEROUS TAILINGS PILES RANGING FROM 10 FEET TO 40 FEET IN ELEVATION ABOVE THE STREAM CHANNEL. MINING ACTIVITIES COMPROMISED THE INTEGRITY OF THE RIVER AND FLOODPLAIN ECOSYSTEM BY SIMPLIFYING AQUATIC HABITAT CONDITIONS, INCREASING STREAM ENERGY, AND REDUCING FLOODPLAIN CONNECTION AND FUNCTION.

IN 2009, TROUT UNLIMITED IN COLLABORATION WITH THE LOLO NATIONAL FOREST INITIATED A PLANNING PROCESS TO EVALUATE RESTORATION FEASIBILITY AND DESIGN AND IMPLEMENT RESTORATION EFFORTS ON A SIX MILE SECTION OF NINEMILE CREEK COMMONLY REFERRED TO AS THE HOUSUM PLACER, A PRIVATE, 250-ACRE MINING CLAIM LOCATED IN TOWNSHIP 18 NORTH, RANGE 24 WEST, IN SECTIONS 21, 22, 23, 25, 28, 27 AND 36. THIS DRAWING SET IS A FINAL DESIGN FOR A 5,800 FOOT SECTION OF NINEMILE CREEK IN REACH 25 AND REACH 2C OF THE PROJECT AREA, INCLUDING BEECHER CREEK AND SAWPIT CREEK. THE GOALS OF THIS PROJECT ARE TO: 1) REHABILITATE STREAM, FLOODPLAIN AND HILLSLOPE PROCESSES IMPAIRED BY PREVIOUS PLACER MINING OPERATIONS; 2) PROMOTE AQUATIC HABITAT CONDITIONS THAT SUPPORT ALL LIFE STAGES OF FISH; AND 3) RECONNECT MAJOR TRIBUTARIES INCLUDING BEECHER CREEK AND SAWPIT CREEK WITH THE MAINSTEM NINEMILE CREEK, AND 4) INCORPORATE THE DESIRES AND NEEDS OF THE LANDOWNERS AND MULTIPLE STAKEHOLDERS.

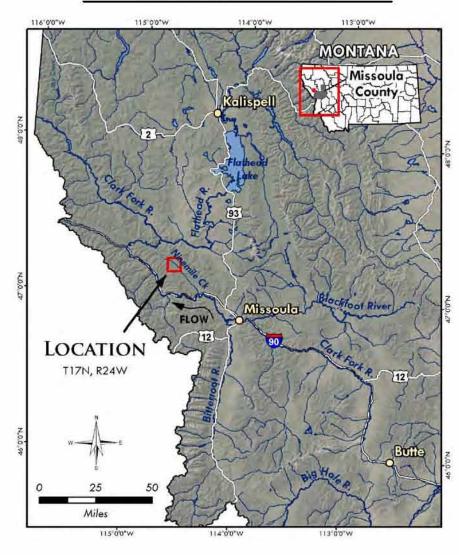
GENERAL NOTES

- 1. CONTOUR INTERVAL IS NOTED ON DRAWINGS
- 2. SLOPES DESIGNATED AS 2:1, 1.5:1, ET CETERA, ARE THE RATIOS OF HORIZONTAL DISTANCE TO VERTICAL DISTANCE.
- 3. DIMENSIONS ARE GIVEN IN FEET AND TENTHS OF A FOOT.
- 4. TOPOGRAPHY AND CROSS SECTION GROUND LINES ARE BASED ON SURVEY WORK PERFORMED FROM JULY TO SEPTEMBER 2013 AND 2012 LIDAR DATA WAS CREATED IN OCTOBER 2011 AND PROVIDED BY TROUT UNLIMITED. ALL LIDAR DATA WAS COORDINATED BY RDG.
- ALL EXISTING CONDITIONS ARE TO BE VERIFIED IN THE FIELD PRIOR TO CONSTRUCTION AND ANY ADJUSTMENTS TO THE DRAWINGS SHALL BE MADE AS DIRECTED BY THE ENGINEER.
- EXISTING PRIVATE IMPROVEMENTS, WHICH LIE WITHIN THE CONSTRUCTION LIMITS, UNLESS OTHERWISE NOTED WILL BE REMOVED BY THE OWNER PRIOR TO CONSTRUCTION, OR ABANDONED IN PLACE.
- PROTECT ALL TREES AND LAND AREAS NOT LOCATED WITHIN THE PROJECT CONSTRUCTION, STAGING OR EARTHWORK LIMITS. EXERCISE CARE IN AREAS NOT SO MARKED TO AVOID UNNECESSARY DAMAGE TO NATURAL VEGETATION.
- 8. THE PROJECT SPONSOR IS RESPONSIBLE FOR COMPLYING WITH ALL PERMITS AND EASEMENTS INCLUDING ALL FEDERAL, STATE, COUNTY, AND LOCAL PERMIT CONDITIONS.
- 9. EXCAVATION, TRENCHING, SHORING, AND SHIELDING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR PERFORMING THE WORK, THESE DRAWINGS ARE NOT INTENDED TO PROVIDE MEANS OR METHODS OF CONSTRUCTION.
- 10. EXCAVATION SHALL MEET THE REQUIREMENTS OF OSHA 26 CFR PART 1626, SUBPART P, EXCAVATIONS. ACTUAL SLOPES SHALL NOT EXCEED THE SLOPES AS INDICATED ON DRAWINGS.
- 11. ENGINEER WILL PROVIDE SURVEY CONTROL AND GRADING SURFACES FOR EQUIPMENT WITH GPS MACHINE CONTROL CAPABILITY. CONTRACTOR SHALL PROVIDE SURVEY STAKING AND LAYOUT FOR CONSTRUCTION.
- 12. VERTICAL TOLERANCE FOR CONSTRUCTION COMPLIANCE WILL BE 0.3 FEET. HORIZONTAL TOLERANCE WILL BE 1.0 FEET.
- CONTRACTOR SHALL CONFIRM QUANTITIES. REPORTED VOLUMES ARE NEATLINE AND DO NOT INCLUDE ADJUSTMENTS FOR COMPACTION OR OTHER FACTORS.

DRAWING INDEX

- 4.6 0010000000
- 2.0 EXISTING CONDITIONS
- 3.0 SITE PLAN
- .1 PLAN VIEW INDEX
- 2 SPECIFICATIONS
- .0 SURVEY CONTROL PLAN
- 4.1 PRESERVATION AND VEGETATION SALVAGE AREAS
- 5.0 PLAN VIEW AND STRUCTURE LAYOUT REACH 2A & 28
- 5.1 GRADING PLAN AND PROFILE REACH 2A & 2B
- 5.2 PLAN VIEW AND STRUCTURE LAYOUT REACH 2B
- 5.3 GRADING PLAN AND PROFILE REACH 2B
- FLAN VIEW AND STRUCTURE LAYOUT REACH 2B
 GRADING PLAN AND PROFILE REACH 2B
- 5.6 PLAN VIEW AND STRUCTURE LAYOUT REACH 2B & 2C
- 5.7 GRADING PLAN AND PROFILE REACH 2B & 2C
- 5.8 PLAN VIEW AND STRUCTURE LAYOUT REACH 2C
- .9 GRADING PLAN AND PROFILE REACH 2C
- 5.10 PLAN AND PROFILE SAWPIT CREEK
- 5.11 GRADING PLAN SAWPIT CREEK
- 5.12 PLAN AND PROFILE BEECHER CREEK
- 3.0 CROSS SECTIONS
- .1 CROSS SECTIONS
- CHANNEL CROSS SECTION DIMENSIONS REACH 2B-1
- 1 CHANNEL CROSS SECTION DIMENSIONS REACH 2B-2 2 CHANNEL CROSS SECTION DIMENSIONS REACH 2B-3
- .3 CHANNEL CROSS SECTION DIMENSIONS REACH 2C-1
- 4 CHANNEL CROSS SECTION DIMENSIONS REACH 2C-2
- 0 LARGE WOOD STRUCTURE TYPE 1
- .1 VEGETATED SOIL LIFT TYPE 1
- 8.2 VEGETATED SOIL LIFT TYPE 2
- 8.3 VEGETATED WOOD AND BRUSH FASCINE TYPE 1 & TYPE 2
- 8.4 CONSTRUCTED RIFFLE DETAIL
- .5 STEP POOL DETAI
- 9.0 FLOODPLAIN FEATURES
- 9.1 FLOODPLAIN TREATMENT AND PLANTING PLAN
- 2 SEEDING PLAN
- 9.3 REVEGETATION SPECIFICATIONS
- 9.4 FLOODPLAIN ROUGHNESS DETAIL
- 9.5 OFF-CHANNEL WETLAND DETAIL
- 9.8 PLANTING AND SEEDING SCHEDULE
- 9.7 RIPARIAN PROTECTION FENCE DETAIL

NINEMILE VICINITY MAP



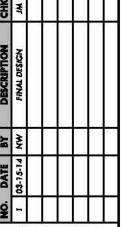
STANDARD OF PRACTICE

RIVER DESIGN GROUP, INC. WORKS EXCLUSIVELY IN THE RIVER ENVIRONMENT AND UTILIZES THE MOST CURRENT AND ACCEPTED PRACTICES AVAILABLE FOR PLANNING AND DESIGN OF RIVER, FLOODPLAIN, AND AQUATIC HABITAT RESTORATION PROJECTS. CURRENT STANDARDS FOR THE DESIGN OF RESTORATION PROJECTS VARY DEPENDING ON PROJECT GOALS. STABILITY CRITERIA INCLUDE DESIGNING STREAMBED AND STREAMBANK STRUCTURES FOR THE 25-YEAR RECURRENCE INTERVAL DISCHARGE FLOOD. HEC-RAS, A ONE-DIMENSIONAL RIVER ANALYSIS MODEL WAS USED TO COMPLETE HYDRAULIC MODELING AND EVALUATE WATER SURFACE ELEVATIONS, CHANNEL AND OVERRANK SHEAR STRESSES, AND VELOCITIES FOR A RANGE OF FLOWS, INCLUDING BANKFULL DISCHARGE, THE 25-YEAR DESIGN STABILITY FLOW, AND HIGHER RETURN INTERVAL DISCHARGES INCLUDING THE 100-YEAR FLOW.

RIVER
DESIGN
GROUP, IN
MINISTAN 31 5W Jefferson Av
Khihelish, MT 39927
Gorvellit, OR

28.3

COVER PAGE



PROJECT NUMBER RDG-13-001

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EXISTING CONDITIONS

THE NINEMILE CREEK - HOUSUM PLACER RESTORATION PROJECT ENCOMPASSES FOUR MILES OF VALLEY AND SIX MILES OF CHANNEL DISTRIBUTED BETWEEN SEVEN STREAM REACHES. MAJOR TRIBUTARIES INCLUDE SAWPIT CREEK, BEECHER CREEK, MARTINA CREEK, MATTIE V CREEK, BURNT CREEK, TWIN CREEK, SOLDIER CREEK, CAMP CREEK, AND LITTLE BEAR CREEK. STREAM AND FLOODPLAIN RESOURCES IN THE PROJECT AREA HAVE BEEN IMPACTED BY LEGACY MINING IMPACTS INCLUDING DREDGE PILES, DRAGLINES, PLACER MINE TAILINGS, AND HILLSLOPE DISTURBANCES.

IN REACHES 2B AND 2C OF THE PROJECT AREA, THE EXISTING RIVER MORPHOLOGY IS CHARACTERIZED BY A MODERATELY TO HIGHLY ENTRENCHED, COBBLE DOMINATED F3 STREAM TYPE (ROSGEN 1996). POOLS ARE LIMITED AND CHANNEL BEDFORMS ARE DOMINATED BY RIFFLE HABITAT UNITS AND A RELATIVELY STRAIGHT CHANNEL PLANFORM WITH AN AVERAGE SINUOSITY OF 1.05. BANKFULL DISCHARGES RANGES FROM 96 CUBIC FEET PER SECOND (CFS) UPSTREAM OF THE SAWPIT CREEK AND BEECHER CREEK CONFLUENCES, TO 140 CFS DOWNSTREAM OF THE FLOW JUNCTURES. THE HISTORICAL PHOTOS SERIES INDICATES A MAJORITY OF THE VALLEY FLOOR WAS DISTURBED PRIOR TO 1964. THE MAIN NINEMILE CREEK ROAD WAS IN PLACE ON THE NORTH SIDE OF THE CHANNEL AND A SECOND TRANSPORTATION CORRIDOR (ROAD PRISM OR RAIL LINE) WAS CONSTRUCTED ON THE SOUTH SIDE OF THE VALLEY. TRANSPORTATION INFRASTRUCTURE BRACKETED THE CHANNEL RESULTING IN LOSS OF FLOODPLAIN CONNECTION AND SEVERE CHANNEL ENTRENCHMENT.

THE CONFINED CONDITION OF THE CHANNEL, AND LACK OF FLOODPLAIN CONNECTION THROUGHOUT A MAJORITY OF THE REACH HAS RESULTED IN SIMPLIFIED AQUATIC HABITAT CONDITIONS AND LOSS OF POOL FORMING STRUCTURE SUCH AS WOOD.

LIMITING FACTORS AND CONSTRAINTS IN REACH 2B AND REACH 2C INCLUDE:

- THE NINEMILE CREEK ROAD AND THE ABANDONED TRANSPORTATION PRISM ON THE SOUTH SIDE OF THE VALLEY CONSTRAIN THE VALLEY WIDTH, LIMIT RIPARIAN AND STREAM FUNCTIONS, AND ARE A SOURCE OF SEDIMENT TO THE CHANNEL.
- . THE EXISTING CHANNEL BASE ELEVATION IS AT A LOWER ELEVATION COMPARED TO THE HISTORICAL FLOODPLAIN SURFACE.
- LOWERING OF THE NINEMILE CREEK CHANNEL BASE ELEVATION INITIATED TRIBUTARY HEADOUTS ON SAWPIT CREEK AND BEECHER CREEK.

NO. DATE
NO.

- REACH BREAK

CONDITION

RESTORATION ALTERNATIVES

RESTORATION ALTERNATIVES FOR THE UPPER NINEMILE CREEK - HOUSUM PLACER RESTORATION PROJECT AREA WERE DEVELOPED BY A MULTI-DISCIPLINARY TEAM CONSISTING OF RESOURCE PROFESSIONALS FROM TROUT UNLIMITED, THE US FOREST SERVICE, RIVER DESIGN GROUP, INC., GEUM ENVIRONMENTAL CONSULTING, INC. AND WESTWATER CONSULTANTS, INC. ALTERNATIVES RANGED FROM NO ACTION (ALTERNATIVE A) TO EXPANDING THE FLOODPLAIN AND CONVERTING THE EXISTING CHANNEL MORPHOLOGY TO MORE NATURAL STREAM TYPES AT THE APPROPRIATE ELEVATIONS (ALTERNATIVE E). A PREFERRED RESTORATION SCENARIO WAS DEVELOPED FOR THE PROJECT AREA BY ASSIGNING THE ALTERNATIVES TO EACH REACH OR SUB-REACH, BASED ON REACH-SPECIFIC LIMITING FACTORS, CONSTRAINTS, AND RESTORATION FEASIBILITY.

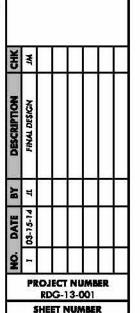
RESTORATION OBJECTIVES

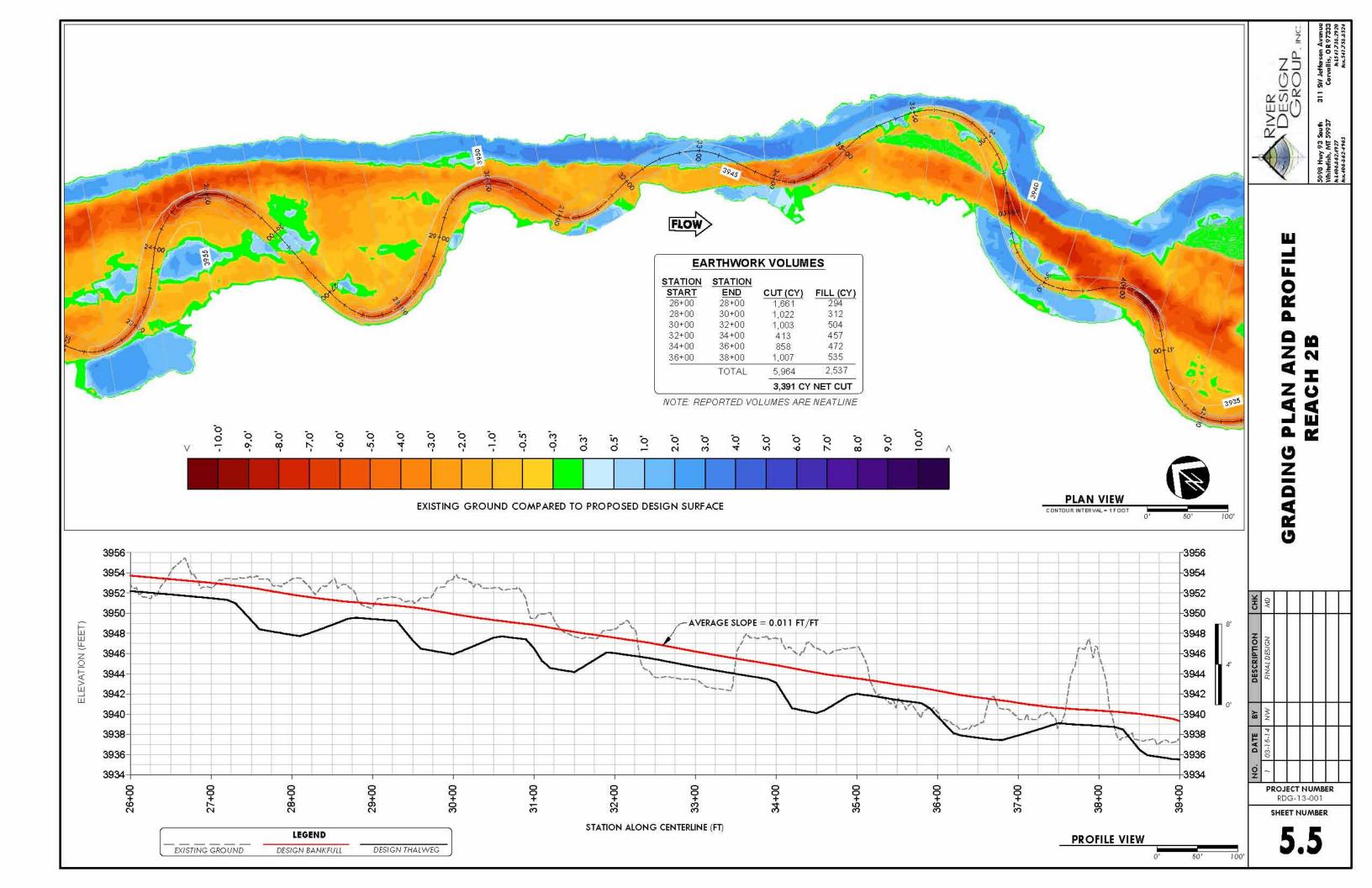
THE REACH 2B AND REACH 2C DESIGN ADDRESSES REACH-SCALE LIMITING FACTORS AND CONSTRAINTS IDENTIFIED IN THE 2012 UPPER NINEMILE CREEK - HOUSUM PLACER RESTORATION PROJECT PHASE 2 ALTERNATIVES DEVELOPMENT REPORT (TROUT UNLIMITED, 2012). OBJECTIVES RELATED TO CHANNEL MORPHOLOGY, AQUATIC HABITAT, FLOODPLAIN RESOURCES, AND RIPARIAN VEGETATION CONDITIONS INCLUDE:

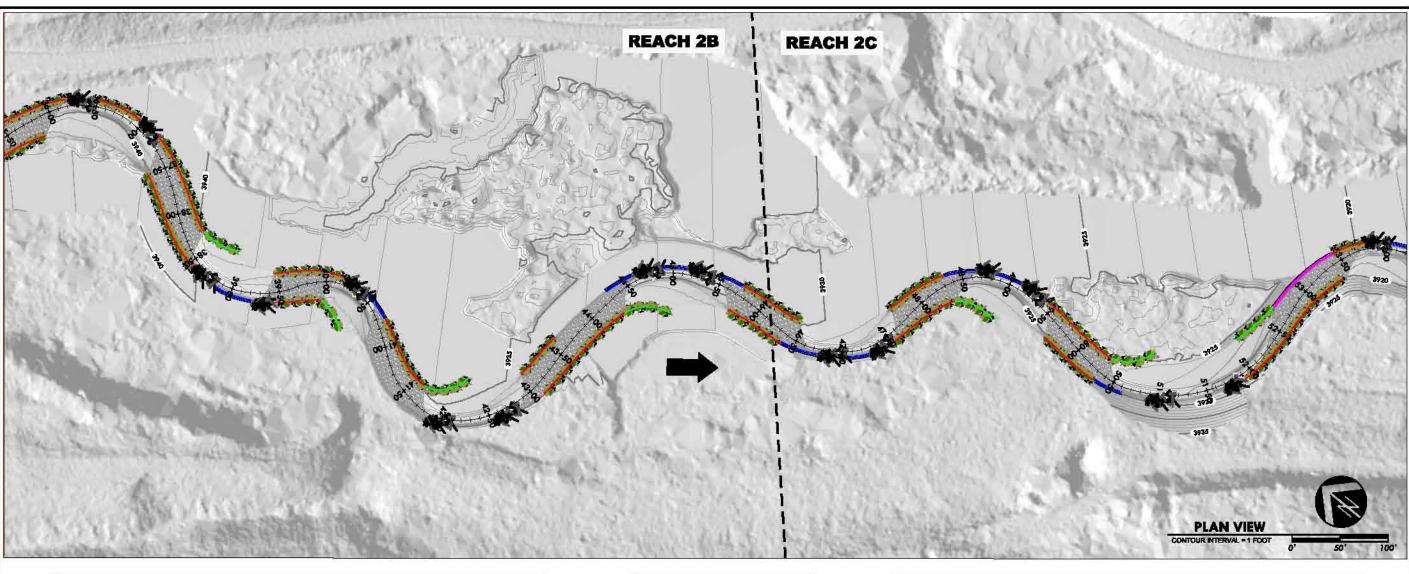
- PRODUCE CLEAN WATER CONSISTENT WITH SUPPORTING AQUATIC LIFE AND BENEFICIAL USES.
- CREATE COMPLEX AQUATIC HABITAT COMPONENTS SUCH AS DEPTH, VELOCITY, SUBSTRATE, COVER, AND POOLS THAT SUPPORT POPULATIONS OF WILD TROUT AND OTHER AQUATIC ORGANISMS.
- CONSTRUCT A STREAM CHANNEL THAT IS CONNECTED TO THE FLOODPLAIN AND INTERACTS WITH THE CHANNEL IN TERMS OF SURFACE FLOW AND SEDIMENT AND NUTRIENT EXCHANGE.
- MAXIMIZE RIPARIAN AND FLOODPLAIN HABITATS AND FUNCTIONS.
- . INCORPORATE, TO THE GREATEST EXTENT FEASIBLE, HISTORICAL FLOODPLAIN AND TERRACE SURFACES.
- RECONNECT THE SAWPIT CREEK AND BEECHER CREEK CONFLUENCES TO IMPROVE FISH PASSAGE AND AQUATIC HABITAT CONDITIONS.
- · REDUCE AVULSION RISK IN UPPER SAWPIT CREEK BY FILLING AN EXISTING DRAGLINE POND.

RESTORATION TREATMENTS

RESTORATION WORK WILL OCCUR ALONG 5,800 FEET OF CHANNEL (1.1 MILES) BEGINNING APPROXIMATELY 1,000 FEET UPSTREAM OF THE CONFLUENCE WITH BEECHER CREEK AND CONTINUING DOWNSTREAM TO THE START OF REACH 2D IN THE PROJECT AREA. RESTORATION WORK WILL BE COMPLETED OVER A TWO-YEAR PERIOD AND WILL BE CLOSELY INTEGRATED WITH PRIVATE LANDOWNERS, THE LOLO NATIONAL FOREST, TROUT UNLIMITED, AND PERMITTING AGENCIES INCLUDING THE MISSOULA CONSERVATION DISTRICT, MONTANA FISH, WILDLIFE & PARKS, MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY, AND THE U.S. ARMY CORPS OF ENGINEERS. THE EXISTING CHANNEL AND FLOODPLAIN MORPHOLOGY WILL BE MODIFIED TO INCLUDE RIFFLE AND POOL STREAM TYPES DEVELOPED WITHIN A BROAD, WELL VEGETATED RIPARIAN FLOODPLAIN CORRIDOR. IN LOCATIONS, THE CHANNEL BED WILL BE RAISED TO RECONNECT VEGETATED TERRACE SURFACES. A VARIETY OF STREAMBED, STREAMBANK, FLOODPLAIN, AND REVEGETATION TREATMENTS WILL BE IMPLEMENTED TO SUPPORT THE RESTORATION OBJECTIVES AND DESIRED OUTCOMES. TREATMENTS WILL BE NATIVE MATERIALS BASED AND DESIGNED TO MIMIC NATURALLY OCCURRING COMPONENTS OF A HEALTHY, FUNCTIONING STREAM CHANNEL AND FLOODPLAIN ECOSYSTEM. STREAMBED TREATMENTS WILL CONSIST OF COMPLEX AQUATIC HABITAT COMPONENTS INCLUDING, RIFFLE, RUN, POOL AND GLIDE FEATURES. STREAMBANK TREATMENTS WILL BE COMPOSED OF WOOD, ALLUVIUM, AND VEGETATION, AND WILL INCREASE BANK RESISTANCE TO EROSION. PROVIDING FOR SHORT-TERM STREAMBED AND STREAMBANK STABILITY IS REQUIRED TO SUPPORT THE VEGETATION DESIGN WHICH EMPHASIZES CREATING A SELF-SUSTAINING MOSAIC OF RIPARIAN AND WETLAND COMMUNITIES ON A FLOODPLAIN SURFACE THAT IS HYDROLOGICALLY CONNECTED TO THE CHANNEL. FLOODPLAIN TREATMENTS INCLUDE A VARIETY OF VEGETATION COVER TYPES THAT INTEGRATE PLANT SPECIES COMPOSITION WITH GEOMORPHOLOGY AND HYDROLOGY, AND ACCOUNT FOR ECOLOGICAL PROCESSES THAT SUPPORT PLANT COMMUNITY DEVELOPMENT OVER TIME. FLOODPLAIN TREATMENTS WILL INCLUDE THE USE OF SWALES, SIDE CHANNELS, OFF-CHANNEL WETLANDS, MICROTOPOGRAPHY, COARSE WOOD, PLANTINGS, AND SEEDING.







LEGEND	
BANK STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE TYPE (LWST 1)	8.0
VEGETATED SOIL LIFT TYPE 1 (VSLT 1)	8.1
VEGETATED SOIL LIFT TYPE 2 (VSLT 2)	8.2
VEGETATED WOOD AND BRUSH FASCINE TYPE 1 (VWBF 1)	8.3
VEGETATED WOOD AND BRUSH FASCINE TYPE 2 (VWBF 2)	8.3
CHANNEL STRUCTURES DETAIL SHEET #	
CONSTRUCTED RIFFLE (CR) 8.4	

CHAN	NE	L TO	P OF	
BANK	ELE	EVAT	TON:	S

STATION	ELEVATION (FT)
39+00	3939.32
39+50	3938.53
40+00	3937.80
40+50	3937.13
41+00	3936.74
41+50	3936.40
42+00	3935.86
42+50	3935.15
43+00	3934.66
43+50	3934.31
44+00	3933.92
44+50	3933.41
45+00	3932.76
45+50	3931.86
46+00	3931.23
46+50	3930.59
47+00	3929.75
47+50	3928.91
48+00	3928.23
48+50	3927.40
49+00	3926.53
49+50	3925.90
50+00	3925.46
50+50	3924.87
51+00	3924.12
51+50	3923.25
52+00	3922.38

STRU	CTURE	SCH	-DUI F

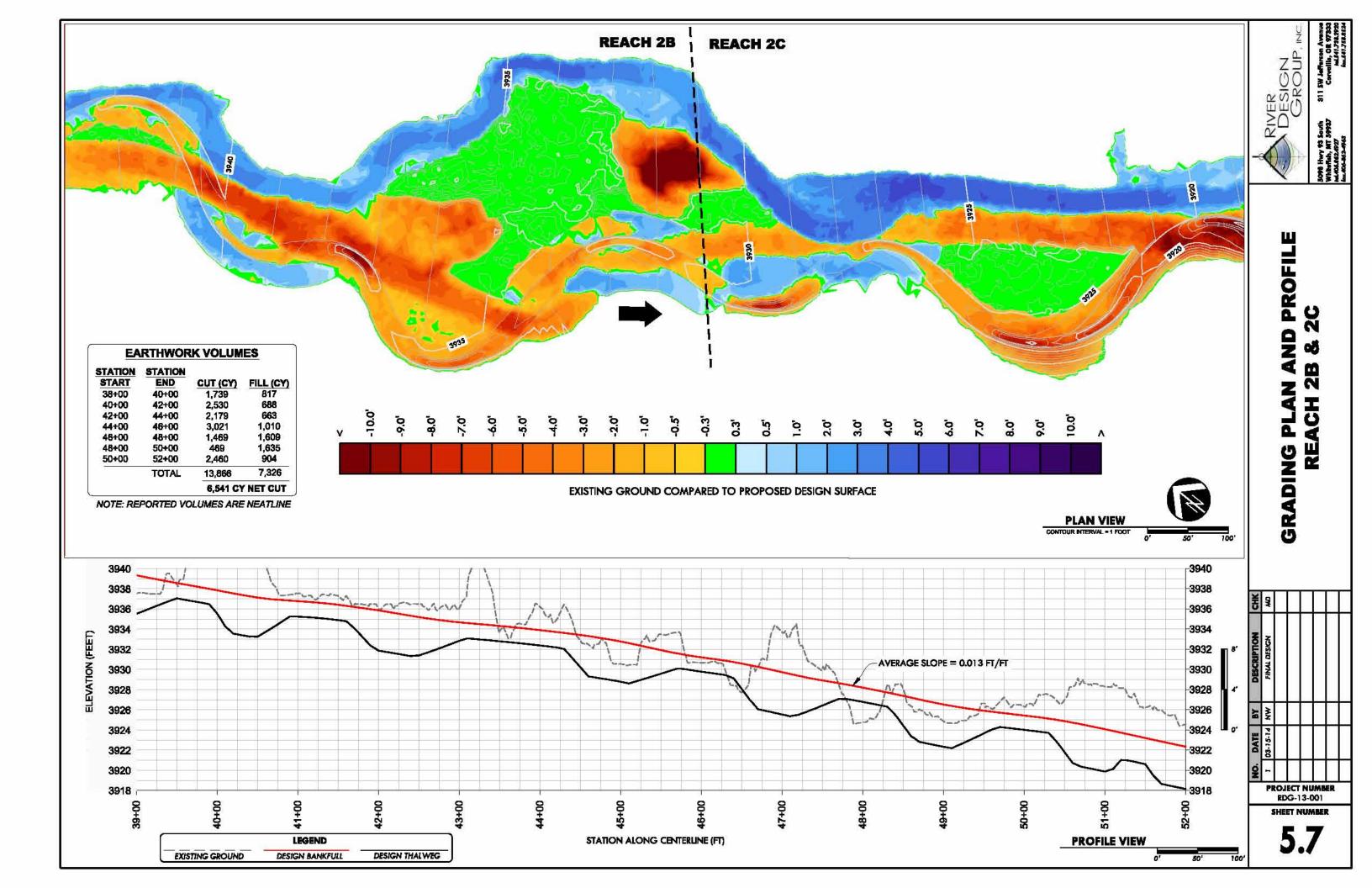
		1000000					
	STATION			STATION	STATION	The second section is a second	
START	END	BANK		START	END		STRUCTURE
39+45	39+95	R	VWBF1	45+72	46+38	C	CR
39+47	40+15	L	VWBF1	45+72	46+38	L	VWBF1
39+49	39+93	C	CR	46+37	46+75	R	VSL2
39+95	40+50	R	VWBF2	46+75	47+05	R	LWS1
40+15	40+45	L	LWS1	47+05	47+25	R	VSL2
40+45	40+73	L	VSL2	47+25	47+50	R	LWS1
40+73	41+63	L	VWBF1	47+50	48+30	R	VWBF1
40+91	41+62	C	CR	47+70	48+30	L	VWBF1
41+63	42+45	L	VWBF2	47+73	48+33	C	CR
41+85	42+10	R	LWS1	48+30	49+00	R	VWBF2
42+55	42+80	R	LWS1	48+65	48+85	L	LWS1
43+05	43+60	L	VWBF1	48+85	49+10	L	VSL2
43+07	44+30	R	VWBF1	48+30	48+65	L	V\$L2
43+08	44+29	C	CR	49+10	49+45	L	LWS1
44+28	44+60	L	VSL2	49+45	50+35	L	VWBF1
44+30	44+95	R	VWBF2	49+67	50+32	C	CR
44+60	44+90	L	LWS1	49+70	50+30	R	VWBF1
44+90	45+15	L	VSL2	49+90	50+15	R	LWS1
45+15	45+45	L	LWS1	50+30	50+60	R	VSL2
45+45	45+72	L	VSL2	50+35	50+85	L	VWBF2
45+70	46+37	R	VWBF1	51+65	51+90	R	LWS1
				51+90	53+40	R	VWBF1
St	ructure Des	scription	ß	Abbrev	viation D	rawing S	iheet
Large Wood Structure Type 1			LW		8.0	-	
Vegetated Soll Lift Type 1			VS	L1	8.1		
Vegetated Soil Lift Type 2			VS	L2	8.2		
			Brush Fascine T	ype 1 VWI	BF1	8.3	
			Brush Fascine T		3F2	8.3	
Er	igineered F	effis		E	3	8.4	

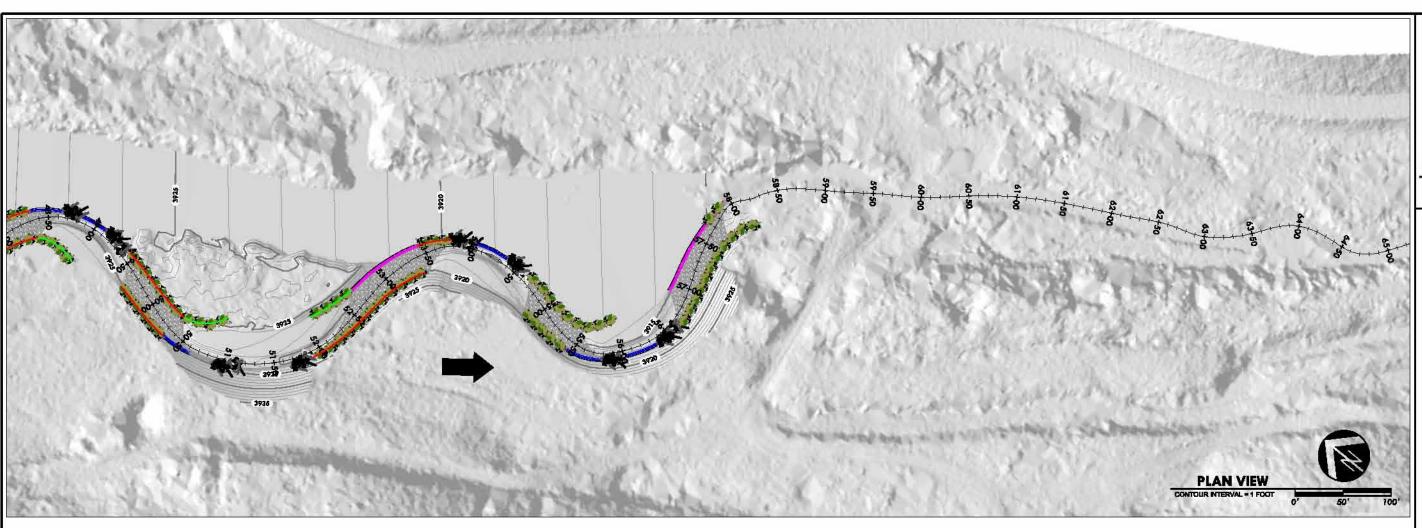


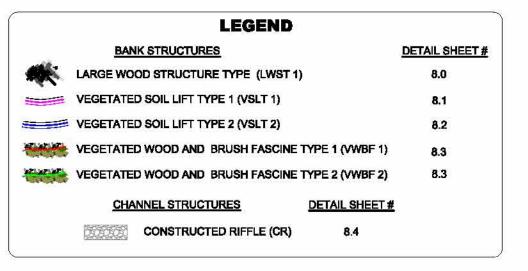
PLAN VIEW AND STRUCTURE LAYOUT REACH 2B & 2C

	NO.	DATE	BY	DESCRIPTION	CHK
PI	-	03-75-74	¥	FINAL DESIGN	Ą
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50					
NI				60 23	
MB					
ED					

PROJECT NUMBER RDG-13-001 SHEET NUMBER







CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)
52+00	3922.38
52+50	3921.66
53+00	3921.06
53+50	3920.29
54+00	3919.42
54+50	3918.61
55+00	3918.08
55+50	3917.49
56+00	3916.64
56+50	3915.84
57+00	3915.35
57+50	3915.01
58+00	3914.53
58+50	3913.78
59+00	3913.04
59+50	3912.31
60+00	3911.63
60+50	3910.88
61+00	3910.23
61+50	3909.46
62+00	3908.76

STRUCTURE SCHEDULE

STATION	STATION		
START	END	BANK	STRUCTURE
52+10	52+65	TL	VWBF2
52+65	53+45	L	VSL1
52+68	53+45	C	CR
53+45	53+80	L	VWBF1
53+80	54+00	L	LWS1
54+00	54+35	L	VSL2
54+35	54+60	L	LWS1
54+60	55+45	L	VWBF1
54+89	55+45	C	CR
54+90	55+45	R	VWBF1
55+45	55+80	R	VSL2
55+80	56+00	L	VWBF2
56+00	56+00	R	LWS1
56+00	56+35	R	VSL2
56+35	56+65	R	LW\$1
56+65	57+70	R	VWBF1
56+90	57+65	L	VSL1
56+91	57+ 8 7	C	CR
57+67	57+95	L	VWBF1
57+95	58+20	R	VWBF2

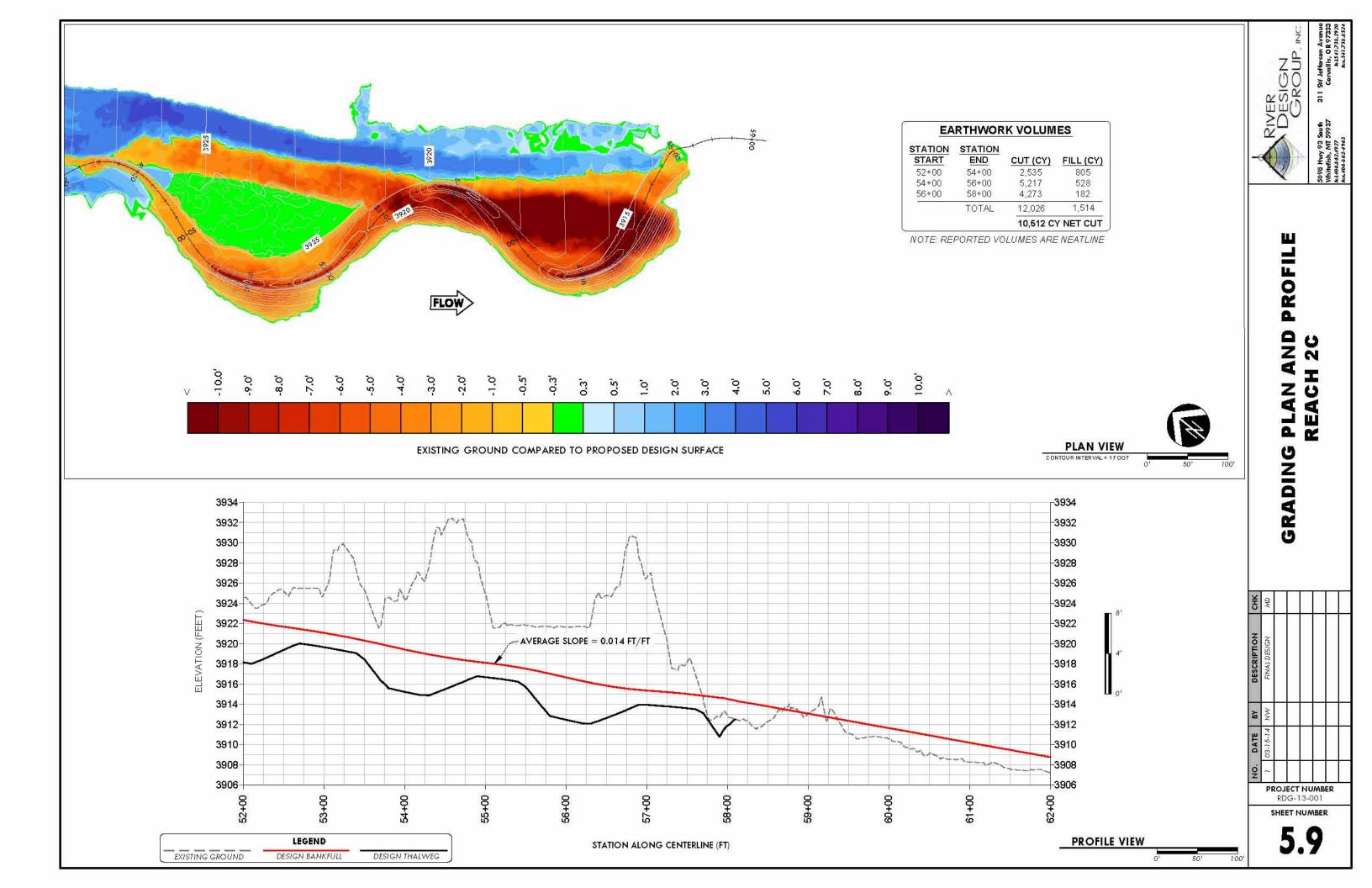
Structure Description	Abbreviation	Drawing Sheet
arge Wood Structure Type 1	LWS1	8.0
Vegetated Soil Lift Type 1	VSL1	8.1
Vegetated Soll Lift Type 2	VSL2	8.2
Vegetated Wood and Brush Fascine Type 1	VWBF1	8.3
Vegetated Wood and Brush Fascine Type 2	VWBF2	8.3
Engineered Riffle	ER	8.4

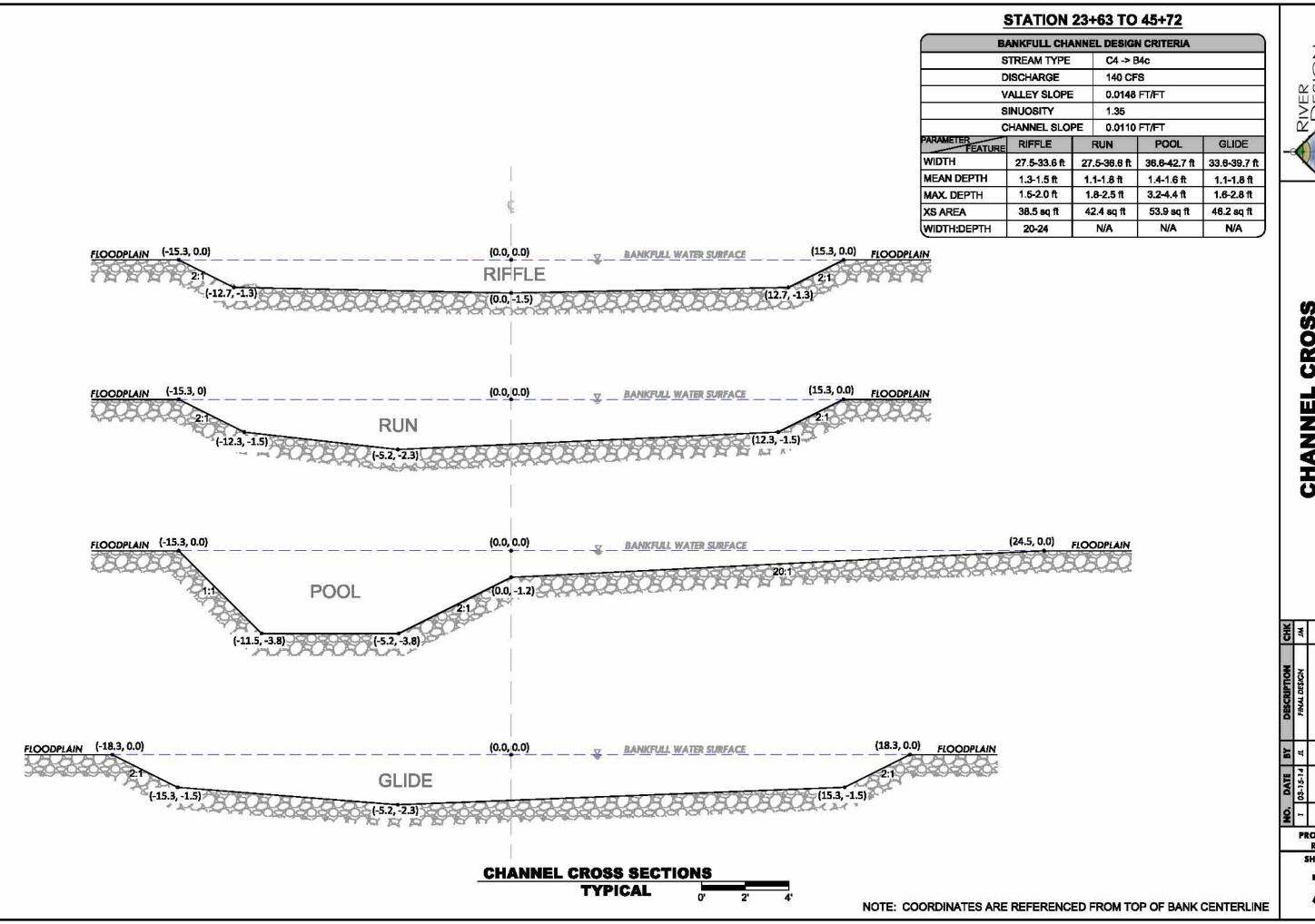
RIVER DESIGN GROUP

PLAN VIEW AND STRUCTURE LAYOU

NO. DATE BY DESCRIPTION CHK
1 03-75-74 NW FINAL DESIGN AD
PROJECT NUMBER BDG-13-001

SHEET NUMBER





SECTION DIMENSIONS CHANNEL CROSS 202 REACH

PROJECT NUMBER

RDG-13-001

STATION 45+72 TO 57+93 BANKFULL CHANNEL DESIGN CRITERIA STREAM TYPE **B4** DISCHARGE 140 CFS VALLEY SLOPE 0.0181 FT/FT SINUOSITY 1.35 CHANNEL SLOPE 0.0151 FT/FT RIFFLE RUN POOL GLIDE WIDTH 26.4-32.2 ft 26.4-35.2 ft 35.2-41.0 ft 32.2-38.1 ft MEAN DEPTH 1.2-1.4 ft 1.1-1.7 ft 1.3-1.5 ft 1.1-1.7 ft MAX. DEPTH 1.4-1.9 ft 1.7-2.4 ft 3.0-4.2 ft 1.5-2.6 ft XS AREA 34.9 sq ft 38.4 sq ft 48.9 sq ft 41.9 sq ft WIDTH:DEPTH 21-25 N/A N/A N/A FLOODPLAIN (-14.7, 0.0) (0.0, 0.0) (14.7, 0.0) FLOODPLAIN RIFFLE (0.0, -1.4) (14.7, 0.0) FLOODPLAIN FLOODPLAIN (-14.7, 0.0) (0.0, 0.0)BANKFULL WATER SURFACE RUN (23.5, 0.0) FLOODPLAIN FLOODPLAIN (-14.7, 0.0) (0.0, 0.0)**POOL** (17.6, 0.0) FLOODPLAIN (0.0, 0.0)FLOODPLAIN (-17.6, 0.0) BANKFULL WATER SURFACE **GLIDE CHANNEL CROSS SECTIONS TYPICAL** NOTE: COORDINATES ARE REFERENCED FROM TOP OF BANK CENTERLINE

RIVER CROUP, INC CROUP, INC States at 3115W Jefferson Aven which, MT 5992 Correllis, OR 973 GARGARTZ CORRELLS, OR 973 GARGARTZ CORRELLS, OR 973 GARGARTZ CORRELLS, OR 973

CHANNEL CROSS SECTION DIMENSIONS REACH 2C - 2

NO. DATE BY DESCRIPTION CHK
1 03-15-14 II FINAL DESIGN IM
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DESIGN INTENT

THE INTENT OF THE LARGE WOOD STRUCTURE IS TO PROVIDE SHORT-TERM STREAMBANK PROTECTION AND STABILIZATION BY RE-DIRECTING FLOW AWAY FROM THE CHANNEL MARGINS, DISSIPATING ENERGY, REDUCING NEAR-BANK STRESS, AND MAINTAINING LATERAL SCOUR POOLS. THE STRUCTURE ALSO PROVIDES BANK STRENGTH TO SUPPORT RIPARIAN VEGETATION ESTABLISHMENT ALONG OUTSIDE MEANDER STREAMBANKS. THE STRUCTURE INCORPORATES SEVERAL TIERS OF BRUSH AND WOOD TO INCREASE CHANNEL MARGIN ROUGHNESS AND PROVIDE NEAR-BANK AQUATIC HABITAT COMPLEXITY. THE STRUCTURE INCLUDES A CONSTRUCTED TOE TO PROVIDE STREAMBANK STABILITY FOR DESIGN EVENT NEAR-BANK SHEAR STRESS CONDITIONS. THE STRUCTURE IS USED IN A SEQUENCE WITH OTHER STREAMBANK STRUCTURES AND IS NOT USED AS A STAND-ALONE TREATMENT.

THE LARGE WOOD STRUCTURE IS USED IN AREAS OF HIGH SHEAR STRESS ALONG THE CHANNEL PLANFORM SPECIFICALLY OUTSIDE MEANDER STREAMBANKS ALONG POOL AND RUN CHANNEL UNITS. OVER TIME, THE STRUCTURE WILL ACCUMULATE ADDITIONAL COARSE WOOD AND DEFORM AS THE CHANNEL MIGRATES ACROSS THE FLOODPLAIN.

CONSTRUCTION NOTES

EXCAVATE TRENCH AND SET FOOTER LOGS AT SPECIFIED DEPTH. USE FOOTER LOGS WITH MINIMUM DIAMETER AND STEM LENGTH AS SPECIFIED. FOOTER LOGS SHALL NOT HAVE A ROOTFAN. IF POSSILBE, BACKFILL UP TO TOP OF FOOTER LOGS WITH SPECIFIED ALLUVIAL BACKFILL. DOUSE BACKFILL PERIODICALLY WITH WATER TO IMPROVE COMPACTION AND MINIMIZE VOID SPACES.

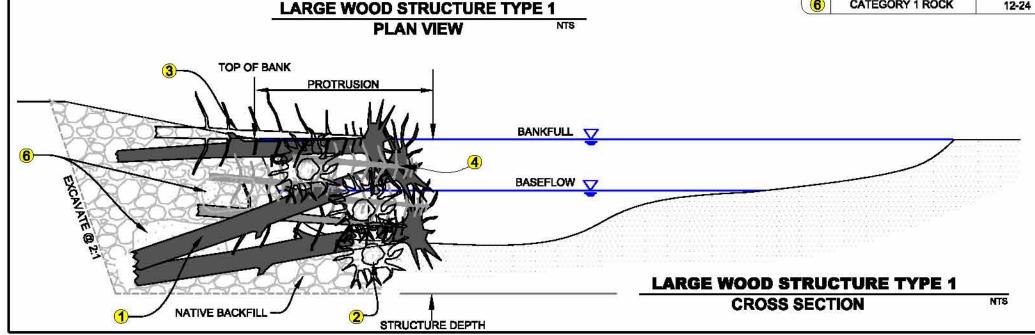
SET ROOTWAD LOGS ON FOOTER LOGS. PLACE LOGS STEMS SLOPING DOWNWARD INTO BANK FROM EDGE OF WATER. USE ROOTWADS WITH MINIMUM ROOTFAN DIAMETER AND STEM LENGTH AS SPECIFIED. BACKFILL UP TO TOP OF ROOTWAD LOGS AND PLACE BALLAST ROCKS ON TOP OF ROOTWAD LOGS AT LOCATIONS WHERE ROOTWAD LOGS INTERSECT FOOTER LOGS. DOUSE BACKFILL PERIODICALLY WITH WATER TO IMPROVE COMPACTION AND MINIMIZE VOID

ADD ADDITIONAL TIER OF FOOTER LOGS AND ROOTWAD LOGS AS SHOWN AND DESCRIBED ABOVE. COVER BALLAST ROCKS AND TOP OF STRUCTURE WITH ALLUVIUM AS APPROVED BY THE CONSTRUCTION MANAGER. PLACE DEFLECTOR LOGS AND BRUSH ON TOP TIERS AS SHOWN.

THE CONSTRUCTION MANAGER SHALL INSPECT AND APPROVE ALL FOOTER LOGS AND ROOTWAD LOGS PRIOR TO BACKFILLING. NOTIFY CONSTRUCTION MANAGER OF ANY PROPOSED CHANGES PRIOR TO IMPLEMENTATION. THE CONSTRUCTION MANAGER RESERVES THE RIGHT TO MODIFY STRUCTURE DESIGN SPECIFICATIONS DURING CONSTRUCTION IF WARRANTED DUE TO UNFORESEEN CONDITIONS.

MATERIAL SCHEDULE (PER STRUCTURE)

	ITEM	DIAMETER (IN)	LENGTH (FT)	ROOTWAD	LIMBS	QUANTITY
1	CATEGORY 1 WOOD	18-24	30	YES	NO	6
2	CATEGORY 2 WOOD	12-18	18-20	YES	NO	
3	CATEGORY 3 WOOD	6-12	10-12	OPTIONAL	YES	10
4	CATEGORY 4 WOOD	6-MINUS	8-12	OPTIONAL	YES	15
6	CATEGORY 1 ROCK	12-24				10



FLOW

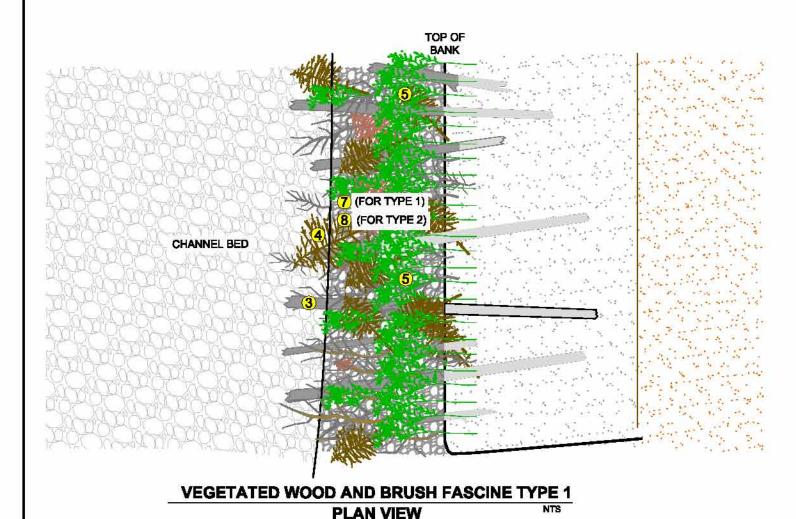
DIRECTION



EXAMPLE OF A LARGE WOOD STRUCTURE

ARGE

RDG-13-010



DESIGN INTENT

THE INTENT OF THE VEGETATED WOOD AND BRUSH FASCINE STRUCTURE IS TO PROVIDE SITE CONDITIONS DIRECTLY ALONG THE CHANNEL BOUNDARIES (STREAMBANKS) THAT ARE SUITABLE FOR GROWING RIPARIAN VEGETATION. THE VEGETATED WOOD AND BRUSH FASCINE STRUCTURE PROVIDES BANK STRENGTH IN THE SHORT-TERM UNTIL MATURE RIPARIAN VEGETATION ESTABLISHES AND PROVIDES LONG-TERM STREAMBANK STABILITY. THE STRUCTURE ALSO PROVIDES CHANNEL MARGIN ROUGHNESS AND NEAR-BANK AQUATIC HABITAT COMPLEXITY.

THE TYPE 1 STRUCTURE IS USED IN ZONES OF HIGH SHEAR STRESS ALONG THE CHANNEL PLANFORM INCLUDING OUTSIDE MEANDER STREAMBANKS, RIFFLE CHANNEL UNITS, AND RUN AND GLIDE CHANNEL UNIT TRANSITIONS. THE STRUCTURE IS USED IN A SEQUENCE WITH OTHER STREAMBANK STABILIZATION STRUCTURES AND IS NOT USED AS A STAND-ALONE TREATMENT. THE TYPE 1 STRUCTURE INCLUDES A CONSTRUCTED TOE TO PROVIDE STREAMBANK STABILITY FOR DESIGN EVENT NEAR-BANK SHEAR STRESS CONDITIONS.

THE TYPE 2 STRUCTURE PROVIDES SIMILAR FUNCTION TO THE TYPE 1 STRUCTURE BUT IS USED IN ZONES OF LOW SHEAR STRESS, OR PASSIVE MARGINS. THE TYPE 2 STRUCTURE DOES NOT INCLUDE A CONSTRUCTED TOE AND IS TYPICALLY PLACED ALONG INSIDE MEANDER STREAMBANKS (E.G. POINT BARS AND MEANDER CORES) TO INCREASE CHANNEL BOUNDARY ROUGHNESS AND SUPPORT RIPARIAN VEGETATION ESTABLISHMENT.

CONSTRUCTION NOTES

VEGETATED WOOD AND BRUSH FASCINE TYPE 1 SHALL BE BUILT ON IMPORTED ALLUVIUM AS SPECIFIED.
VEGETATED WOOD AND BRUSH FASCINE TYPE 2 SHALL BE BUILT ON SUITABLE NATIVE ALLUVIUM AS SPECIFIED.
THE CONSTRUCTION MANAGER SHALL VIEW AND APPROVE FOUNDATION LAYER. BRUSH TOE SHALL BE PLACED IN CONJUNCTION WITH NATIVE ROCK AND LAYERED TO AT A 1:1 SLOPE TO CREATE THE TOE OF THE STRUCTURE.
MATERIAL AND SHALL BE STABILIZED DOWN TO THE MAXIMUM ANTICIPATED RUN SCOUR DEPTH.

INTERLACE LIVE CUTTINGS WITH BRUSH, WOOD AND NATIVE ALLUVIUM TO CREATE THE DESIGN BANK. CUTTINGS SHALL BE A MIN. LENGTH OF 8' AND MIN. WIDTH OF 0.25" WITH A MAXIMUM OF 2' FEET EXPOSED. INSTALL WHILE VEGETATION IS DORMANT.

NOTIFY CONSTRUCTION MANAGER OF ANY PROPOSED CHANGES PRIOR TO IMPLEMENTATION. THE CONSTRUCTION MANAGER RESERVES THE RIGHT TO MODIFY STRUCTURE DESIGN SPECIFICATIONS DURING CONSTRUCTION IF WARRANTED DUE TO UNFORESEEN CONDITIONS.

MATERIAL SCHEDULE (PER LINEAR FOOT)

	<u>ITEM</u>	DIAMETER (IN)	LENGTH (FT)	ROOTWAD	LIMBS	QUANTITY
3	CATEGORY 3 WOOD	6-12	10-12	OPTIONAL	YES	2
4	CATEGORY 4 WOOD	6-MINUS	8-12	OPTIONAL	YES	3
5	RIPARIAN CUTTINGS	0.25	6-8		YES	10
7	CATEGORY 2 ROCK	6-PLUS				0.25
8	CATEGORY 3 ROCK	6-MINUS				0.25



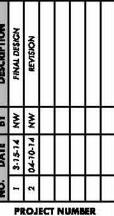
EXAMPLE OF A CONSTRUCTED VEGETATED WOOD AND BRUSH FASCINE

RIVER DESIGN GROUP,

VEGETATED WOOD AND BRUSH FASCINE TYPE 1 & TYPE 2

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DESCRIPTION	FINAL DESIGN	REVISION				
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DATE	71-51-E	P1-01-70				
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RDG-13-010



RDG-13-010 SHEET NUMBER

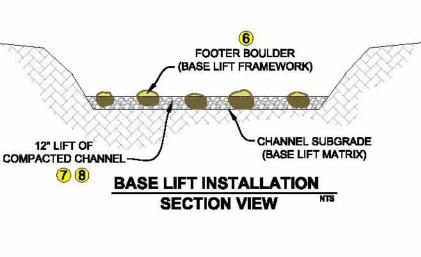
TYPICAL CONSTRUCTED RIFFLE

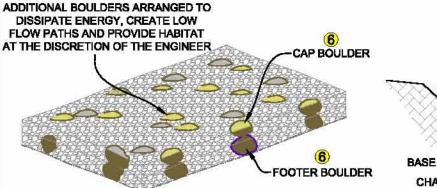
DESIGN INTENT

THE INTENT OF THE CONSTRUCTED RIFFLE IS TO PROVIDE A STABLE CONSTRUCTED SURFACE COMPRISED OF NATIVE AND IMPORTED (WHEN NECESSARY) SUBSTRATE. THE ENGINEERED FILL IS USED TO INCREASE THE RIVER CHANNEL BED ELEVATION AND IS TYPICALLY CONSTRUCTED TO FORM RIFFLE, RUN, AND GLIDE HABITAT UNITS. THE FILL COMPOSITION INCLUDES THREE PRIMARY SUBSTRATE CLASSIFICATIONS INCLUDING GRAVELS, COBBLES, BOULDERS, AND FINES. GRAVELS AND COBBLES FORM THE ENGINEERED FILL MATRIX. BOULDERS PROVIDE SCOUR RESISTANCE, INFLUENCE LOW FLOW STREAM FLOW PATTERNS AND HYDRAULICS, AND CREATE HABITAT. FINES ARE WASHED INTO THE MATRIX MATERIAL TO SEAL THE STREAMBED TO REDUCE PERCOLATION LOSSES AND BED MATERIAL MOVEMENT. BOULDERS PROTRUDE FROM THE ENGINEERED FILL SURFACE TO PROMOTE DIVERSE FLOW PATHS, PROVIDE ENERGY DISSIPATION, AND CREATE AQUATIC HABITAT.

CONSTRUCTION NOTES

- CONTRACTOR TO STOCKPILE ENGINEERED FILL MATERIAL PER DESIGN SPECIFICATIONS. MATERIALS ARE TO BE STOCKPILED IN THE IMMEDIATE PROJECT AREA.
- 2. TREAT EXISTING CHANNEL BED BY REMOVING ORGANICS AND CREATING A PRISMATIC WORKING SURFACE, ALL LARGE COBBLE AND BOULDERS SHALL BE SALVAGED AND STOCKPILED.
- 3. PREPARE THE BASE LIFT FRAMEWORK. CONTRACTOR SHALL PLACE CATEGORY 1 ROCK (FOOTER BOULDERS) ON THE SURFACE OF THE CHANNEL SUBGRADE AS INDICATED ON THE DRAWING.
- 4. PREPARE THE BASE LIFT MATRIX. AFTER THE BASE LIFT FRAMEWORK IS PREPARED AND INSPECTED BY ENGINEER, PLACE A MIXTURE OF CATEGORY 1 AND CATEGORY 2 ROCK (BASE LIFT MATRIX) IN BASE LIFT AND WASH FINES INTRO STREAMBED TO CREATE A MATRIX SURROUNDING BASE LIFT FRAMEWORK. CHANNEL ALLUVIUM SHALL BE PLACED TO THE FULL COURSE THICKNESS IN LIFTS OF 12-INCHES. INDIVIDUAL COURSES SHALL BE BUCKET COMPACTED.
- 5. PREPARE THE TOP LIFT FRAMEWORK. CONTRACTOR SHALL PLACE CATEGORY 1 ROCK (CAP BOULDERS) IN CONTACT WITH THE FOOTER BOULDERS. CAP ROCKS SHALL BE SET AND ORIENTED 0.5-FT. UPSTREAM OF THE FOOTER ROCK WITH NO LESS THAN 50% OF THE CAP BOULDER SURFACE AREA IN CONTACT WITH THE FOOTER BOULDER. DUE TO THE INHERENT VARIABILITY IN MATERIALS. CAP ROCK ELEVATIONS SHALL BE ADJUSTED TO ASSURE BOULDER PROTRUSION ABOVE FINISH GRADE IS NO GREATER THAN 1.0-FT.
- 6. PREPARE THE TOP LIFT MATRIX. AFTER THE TOP LIFT FRAMEWORK IS PREPARED AND INSPECTED BY ENGINEER, PLACE A MIXTURE OF CATEGORY 1 AND CATEGORY 2 ROCK (TOP LIFT MATRIX) IN TOP LIFT AND WASH FINES INTRO STREAMBED TO CREATE A MATRIX SURROUNDING TOP LIFT FRAMEWORK. CHANNEL ALLUVIUM SHALL BE PLACED TO THE FULL COURSE THICKNESS IN LIFTS OF 12-INCHES TO FINISHED GRADE. INDIVIDUAL COURSES SHALL BE BUCKET COMPACTED.





BASE LIFT INSTALLATION

3-D VIEW

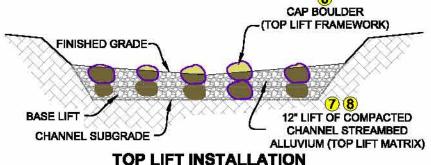
FOOTER BOULDER

(BASE LIFT FRAMEWORK)

12" LIFT OF COMPACTED **CHANNEL STREAMBED**

ALLUVIUM (BASE LIFT MATRIX)





TOP LIFT INSTALLATION SECTION VIEW



CHANNEL SUBGRADE





BASE LIFT MATRIX





NOTE: PRIOR TO INSTALLATION ALL LARGE COBBLE AND BOULDERS

SHALL BE SALVAGED FROM

EXISTING CHANNEL.

TYPICAL CONSTRUCTED RIFFLE



MATERIAL SCHEDULE (PER LINEAR FOOT) ITEM DIAMETER (IN) QUANTITY **CATEGORY 1 ROCK** 12-24 0.6 EA

6-PLUS

6-MINUS

CATEGORY 2 ROCK

CATEGORY 3 ROCK



1.0 CY

0.5 CY